Vector-Borne Disease Ecology of the Middle East

Michael J. Cuomo, MPH

Tulane University
School of Public Health & Tropical Medicine
ScD Program

United States Air Force, ANG
Biomedical Services Corps
Public Health

OVERVIEW

- Brief Description of Countries in the Middle East
- Militarily Important Vector-Borne Diseases with Short Incubation Periods (<15 days)
- Militarily Important Vector-Borne Diseases with Long Incubation Periods (>15 days)
- Other Diseases of Military Significance
- Noxious / Venomous Animals and Plants of Military Significance

Brief Description of Countries in the Middle East

- Bahrain
- Cyprus
- Iran
- Iraq
- Israel
- Jordan
- Kuwait
- Lebanon
- Oman
- Qatar
- Saudi Arabia
- Syria
- Turkey
- United Arab Emirates
- Yemen


MIDDLE EAST
RUSSIA
KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
Black Sea
Caspian Sea
BULGARIA
Bucharest
Sofia
Constanta
Varna
Sevastopol'
Krasnodar
Grozny
Sokhumi
GEORGIA
Tbilisi
Istanbul
Samsun
Bat'umi
Trabzon
ARMENIA
Yerevan
AZERBAIJAN
Baku
Sumqayit
Türkmenbaşy
Balkanabat
Türkmenabat
Ashgabat
Mary
Nukus
GREECE
Athens
Izmir
Ankara
TURKEY
Kayseri
Konya
Antalya
Adana
Gaziantep
Diyarbakir
Tabriz
Rasht
Zanjan
Qazvin
Tehran
Qom
Mashhad
Herat
AFG.
Nicosia
CYPRUS
Aleppo
SYRIA
Mosul
Arbil
Kirkuk
Beirut
LEBANON
Damascus
Golan Heights
Mediterranean Sea
Haifa
ISRAEL
Jerusalem
Amman
Alexandria
Port Said
Cairo
Al Jizah
Gaza Strip
Suez
JORDAN
Al Aqabah
Baghdad
IRAQ
Kermanshah
ZAGROS MOUNTAINS
Esfahan
IRAN
Ahvaz
Abadan
An Nasiriyah
Al Basrah
Kerman
Zahedan
PAK.
Kuwait
KUWAIT
Shiraz
Bushehr
Tabuk
Ha'il
Hafar al Batin
Bandar 'Abbas
EGYPT
WESTERN DESERT
Asyut
Luxor
Aswan
Al Jubayl
Ad Dammam
Manama
Dhahran
BAHRAIN
QATAR
Doha
Abu Dhabi
Dubai
Buraydah
Riyadh
Muscat
Medina
Yanbu' al-Bahr
SAUDI ARABIA
UNITED ARAB EMIRATES
Hala'ib
Jiddah
Mecca
OMAN
NUBIAN DESERT
RUB' AL KHALI
Red Sea
Port Sudan
Abha
SUDAN
Salalah
Jizan
Omdurman
Khartoum
ERITREA
Massawa
Asmara
Sanaa
YEMEN
Al Ghaydah
Arabian Sea
Wad Madani
Al Hudaydah
Al Mukalla
Aden
Gulf of Aden
Socotra (YEMEN)
DJIBOUTI
Djibouti
Dese
Scale 1:21,000,000
Lambert Conformal Conic Projection, standard parallels 12°N and 38°N
Addis Ababa
Berbera
Hargeysa
SOMALIA
ETHIOPIA
500 Kilometers
500 Miles

VECTOR-BORNE DISEASES IN THE MIDDLE EAST (+ = present; ? = Uncertain)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
malaria			+	+					+		+	+	+	+	+
sand fly fever	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dengue											?				
epidemic typhus					?			?							
louse-borne relapsing fever		?	+	+	+	+	?	+	?		?	+	+		?
tick-borne relapsing fever			+	+	+	+	?	+	?		?	+		?	+
CCHF	+		+	+	+	+	+	+	+	+	+	+	+	+	+
boutonneuse fever	?		?		+	+		+	?		?	+	+	?	?
tick-borne encephalitis													+		
Q fever	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
murine typhus		?	+	+	+	+	+	+	+	?	+	+	+		+
plague			+	+				+			+	+	+		+
West Nile virus	+		+	+	+	+	+	+	+	+	+	+	+	+	+
Sindbis virus	+		+	+	+	+	+	+	+	+	+	+	+	+	+
cutaneous leishmaniasis	+		+	+	+	+	+	+	?	?	+	+	+	?	+
visceral leishmaniasis	+		+	+	+	?	+	+	+	+	+	+	+	+	+
schistosomiasis			+	+		+	+	+	+		+	+	+		+
onchocerciasis									?		+				+
Bancroftian filariasis			+						+		+				+
Lyme disease					+								+		
leptospirosis	+		+	+	+	+	+	+	+	?	+	+	+	?	+
hantavirus													+		

GEOGRAPHY

- Over 6 million sq km of land
- Topology – mainly flat lowlands or plateaus, with several mountain ranges in the north and in coastal areas.
- Relief varies from the highest peak, Qolleh-ye Damavand in northern Iran at 5,671 m above sea level, to the Dead Sea, bordered by Jordan and Israel, at 400 m below sea level
- Sits atop roughly half of the world's known reserves of petroleum

CLIMATE

- Overall characterized as arid
- Annual precipitation –
  - Turkey and Lebanon - 640 mm
  - Qatar and Yemen – 80 mm
  - ME Average 230 mm
- Prevailing winds – W or NW
- Each country has its unique pattern of weather

PEOPLE & POPULATION

- A mixture of many different cultures, races, religions, and ethnic backgrounds
- Numerous wars, migrations, natural upheavals, and routine trade activities by outside cultures, governments, religious orders, armies, and individuals over several thousand years have led to nearly every imaginable combination of genetic and cultural mixing
- Vast majority are Muslim (Shi'a or Sunni) with the exception of Israel (Jews) and Cyprus (Christian)

WATER, LIVING & SANITARY CONDITIONS

- Water is a precious resource
- Over use, depletion of groundwater, and contamination (pollution) of natural surface water and aquifers by human, animal, industrial and agricultural wastes have further reduced supplies
- Poor sanitation supports large populations of rodents, flies, mosquitoes, and other vectors

BAHRAIN


SAUDI ARABIA
50°20'
MANAMA
Al Muḥarraq
Jidd Ḥafş
Mīnā' Salmān
Sitrah
Madīnat 'Īsá
Umm an Na'san
Ar Rifā' ash Sharqī
'Awālī
Jabal ad Dukhan
26°00'
Gulf of Bahrain
Gulf of Bahrain
ḤAWĀR ISLANDS
25°40'
SAUDI ARABIA
0 5 10 km
0 5 10 mi
50°20'
50°40'
QATAR

BAHRAIN

- Location - archipelago in the Persian Gulf, east of Saudi Arabia
- Area –
  - *total:* 665 sq km
  - *water:* 0 sq km
  - *land:* 665 sq km
- Size - 3.5 times the size of Washington, DC
- Coastline - 161 km
- Natural Resources - oil, associated and nonassociated natural gas, fish, pearls

BAHRAIN

- Climate - arid; mild, pleasant winters; very hot, humid summers
- Terrain - mostly low desert plain rising gently to low central escarpment
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* Jabal ad Dukhan 122 m
- Environmental Issues - desertification resulting from the degradation of limited arable land, periods of drought, and dust storms; coastal degradation (damage to coastlines, coral reefs, and sea vegetation) resulting from oil spills and other discharges from large tankers, oil refineries, and distribution stations; lack of freshwater resources, groundwater and seawater are the only sources for all water needs

CYPRUS


Mediterranean Sea
Cape Andreas
Rizokarpaso
Cape Plakoti
Yialousa
Leonarisso
KARPAS PENINSULA
Cape Kormakiti
Liveras
Ayios Amvrosios
Dhavlos
Kyrenia
Akanthou
Myrtou
KYRENIA RANGE
Trikomo
Morphou Bay
Kythrea
Famagusta Bay
Morphou
MESAORIA
Khrysokhou Bay
Letka
NICOSIA
Vatili
Famagusta
Cape Arnauti
Athienou
Koutsia
U.N. cease-fire line
Evrykhou
Polis
Pano Panayia
TROODOS MTS.
Olympus
Dhali
Dhekelia
Cape Greco
Larnaca Bay
Peyia
Larnaca
Ktima
Kalokhorio
Kophinou
Paphos
CYPRUS
Evdhimou
Episkopi
Lemesos
Akrotiri Bay
Episkopi Bay
Akrotiri
Cape Gata

CYPRUS

- Location - island in the Mediterranean Sea, south of Turkey
- Area -
  - *total:* 9,250 sq km (of which 3,355 sq km are in the Turkish Cypriot area)
  - *water:* 10 sq km
  - *land:* 9,240 sq km
- Size - about 0.6 times the size of Connecticut
- Coastline - 648 km
- Natural Resources - copper, pyrites, asbestos, gypsum, timber, salt, marble, clay earth pigment

CYPRUS

- Climate - temperate; Mediterranean with hot, dry summers and cool winters
- Terrain - central plain with mountains to north and south; scattered but significant plains along southern coast
- Elevation Extremes -
  - *lowest point:* Mediterranean Sea 0 m
  - *highest point:* Olympus 1,951 m
- Environmental Issues – water resource problems (no natural reservoir catchments, seasonal disparity in rainfall, sea water intrusion to island's largest aquifer, increased salination in the north); water pollution from sewage and industrial wastes; coastal degradation; loss of wildlife habitats from urbanization


Turkmenistan
Uzbekistan
Turkey
Caspian Sea
Azerbaijan
Armenia
YEREVAN
BAKU
Krasnovodsk
Bukhoro
Qarshi
Chärjew
Amu Darya (Oxus)
Kizyl-Arvat
ASHGABAT
Mary
Erzurum
Karaköse
Tatvan
Van
Kurtalan
Tigris
Al Qāmishlī
Dahūk
Mosul
Irbīl
Syria
Kirkūk
Sāmarrā'
Ḥadīthah
BAGHDAD
Iraq
Karbalā'
Al Kūt
An Najaf
Al 'Amārah
Euphrates
Al Başrah
UNIKOM Zone
Kuwait
KUWAIT
Rafḥā'
Ḩafar al Bāţin
Ra's al Khafjī
King Khalid Military City
Ḩā'il
'Unayzah
Saudi Arabia
Al Jubayl
Ad Dammām
Al Hufūf
RIYADH
Al Kharj
'Afīf
Bahrain
MANAMA
Qatar
DOHA
1965 boundary renegotiated and revised in 1992, not official depiction
De Facto Boundary
agreed-upon maritime boundary
United Arab Emirates
ABU DHABI
Dubayy
Oman
MUSCAT
Administrative Line
Persian Gulf
Strait of Hormuz
Gulf of Oman
Arabian Sea
Marand
TABRĪZ
Ardebīl
Āstārā
ORŪMĪYEH
Lake Urmia
Mahābād
RASHT
ZANJĀN
Qazvīn
Qolleh-ye Damavand 5671m
TEHRĀN
Karaj
Eslāmshahr
SARĪ
Gorgān
Shāhrūd
SEMNĀN
Bojnūrd
MASHHAD
SANANDAJ
HAMADĀN
BAKHTARAN (Kermanshah)
ĪLĀM
ARĀK
Qom
Kāshān
KHORRAMABĀD
Dezfūl
AHVĀZ
Khorramshahr
Ābādān
Bandar-e Khomeynī
EŞFAHĀN
SHAHR-E KORD
YĀSŪJ
Nā'īn
Pasargadae
SHĪRĀZ
BANDAR-E BŪSHEHR
Kangān
Lār
BANDAR-E ABBĀS
Bandar-e Lengeh
Sar Cheshmeh
Sīrjān
KERMĀN
Bam
Dasht-e Kavīr (salt desert)
Kavīr-e Namak
Iran
Tayyebāt
Bīrjand
ZĀHEDĀN
Zābol
Īrānshahr
Jāsk
Bandar Beheshtī
Kushka
Herāt
Qal'eh-ye Now
Meymaneh
Afghanistan
Farāh
Gereshk
Zaranj
Helmand
Nok Kundi
Pakistan
Turbat
Gwādar
SCALE 1:11,250,000
0 100 200 300 Kilometers
0 100 200 300 Miles
Lambert Conformal Conic Projection, standard parallels 12°N and 38°N
International boundary
National capital
Province capital
Railroad
Expressway
Road

IRAN

- Location - bordering the Gulf of Oman, the Persian Gulf, and the Caspian Sea, between Iraq and Pakistan
- Area -
  - *total:* 1.648 million sq km
  - *land:* 1.636 million sq km
  - *water:* 12,000 sq km
- Size - slightly larger than Alaska
- Coastline - 2,440 km; note - Iran also borders the Caspian Sea (740 km)
- Natural Resources - petroleum, natural gas, coal, chromium, copper, iron ore, lead, manganese, zinc, sulfur

IRAN

- Climate - mostly arid or semiarid, subtropical along Caspian coast
- Terrain - rugged, mountainous rim; high, central basin with deserts, mountains; small, discontinuous plains along both coasts
- Elevation Extremes –
  - *lowest point:* Caspian Sea -28 m
  - *highest point:* Qolleh-ye Damavand 5,671 m

IRAN

- Environmental Issues - air pollution, especially in urban areas, from vehicle emissions, refinery operations, and industrial effluents; deforestation; overgrazing; desertification; oil pollution in the Persian Gulf; wetland losses from drought; soil degradation (salination); inadequate supplies of potable water; water pollution from raw sewage and industrial waste; urbanization

IRAQ


TURKEY
SYRIA
IRAN
SAUDI ARABIA
KUWAIT
JOR
unnamed peak
Arbīl
Mosūl
As Sulaymānīyah
Kirkuk
Buḥayrat ath Tharthār
Sāmarrā'
BAGHDAD
Ar Ramādī
Ar Ruṭbah
Buḥayrat ar Razāzah
Karbalā'
Al Kūt
An Najaf
Euphrates
Tigris
An Nāṣirīyah
Al Başrah
Umm Qasr
Shatt al Arab
Persian Gulf
0 50 100 km
0 50 100 mi
40
45
35
30

IRAQ

- Location – bordering the Persian Gulf, between Iran and Kuwait
- Area –
  - *total:* 437,072 sq km
  - *water:* 4,910 sq km
  - *land:* 432,162 sq km
- Size – slightly more than twice the size of Idaho
- Coastline – 58 km
- Natural Resources - petroleum, natural gas, phosphates, sulfur

IRAQ

- Climate - mostly desert; mild to cool winters with dry, hot, cloudless summers; northern mountainous regions along Iranian and Turkish borders experience cold winters with occasionally heavy snows that melt in early spring, sometimes causing extensive flooding in central and southern Iraq
- Terrain – mostly broad plains; reedy marshes along Iranian border in south with large flooded areas; mountains along borders with Iran and Turkey
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* unnamed peak 3,611 m

IRAQ

- Environmental Issues - government water control projects have drained most of the inhabited marsh areas east of An Nasiriyah by drying up or diverting the feeder streams and rivers; a once sizable population of Marsh Arabs, who inhabited these areas for thousands of years, has been displaced; furthermore, the destruction of the natural habitat poses serious threats to the area's wildlife populations; inadequate supplies of potable water; development of the Tigris and Euphrates rivers system contingent upon agreements with upstream riparian Turkey; air and water pollution; soil degradation (salination) and erosion; desertification


Israel
International boundary
District (meḩoz) boundary
National capital
District (meḩoz) center
Railroad
Divided highway
Other road
0 40 Kilometers
0 40 Miles
The 1950 Israeli proclamation that Jerusalem be the national capital is not recognized by the United States Government.
Mediterranean Sea
SYRIA
JORDAN
EGYPT
SINAI
SAUDI ARABIA
NORTHERN
HAIFA
CENTRAL
TEL AVIV
JERUSALEM
SOUTHERN
WEST BANK
(Israeli occupied-status to be determined)
GAZA STRIP
(Israeli occupied-status to be determined)
GOLAN HEIGHTS
(Israeli occupied)
UNDOF Zone
1950 Armistice Line
1949 Armistice Line
1967 Cease-Fire Line
Tyre
Marj'i'yun
Qiryat Shemona
Al Qunaytirah
Nahariyya
'Akko
Haifa
Tiberias
Lake Tiberias
Nazareth
Hadera
Janin
Netanya
Tulkarm
Nabulus
Herzliyya
Tel Aviv-Yafo
Bat Yam
Rehovot
Ramla
Ram Allah
Jericho
Ashdod
Jerusalem
Ashqelon
Bethlehem
Qiryat Gat
Gaza
Hebron
Dead Sea
Khan Yunus
Beersheba
Dimona
Zefa'
Mizpe Ramon
Yotvata
Elat
Taba
Al 'Aqabah
Gulf of Aqaba
Al 'Arish
Bi'r Lahfan
Abu 'Ujaylah
'Ayn al Qusaymah
Bi'r Hasanah
Al Kuntillah
An Nakhl
Irbid
Dar'a
As Suwayda'
Busra ash Sham
Al Mafraq
Jarash
Az Zarqa'
Amman
Madaba
Al Qatranah
Al Karak
As Safi
Al Jafr
Ma'an
Ra's an Naqb
Al Mudawwarah
Boundary representation is not necessarily authoritative.
Base 801245 (A00853) 12-88

ISREAL

- Location – bordering the Mediterranean Sea, between Egypt and Lebanon
- Area –
  - *total:* 20,770 sq km
  - *water:* 440 sq km
  - *land:* 20,330 sq km
- Size – slightly smaller than New Jersey
- Coastline – 273 km
- Natural Resources - timber, potash, copper ore, natural gas, phosphate rock, magnesium bromide, clays, sand

ISREAL

- Climate - temperate; hot and dry in southern and eastern desert areas
- Terrain – Negev desert in the south; low coastal plain; central mountains; Jordan Rift Valley
- Elevation Extremes –
  - *lowest point:* Dead Sea -408 m
  - *highest point:* Har Meron 1,208 m
- Environmental Issues - limited arable land and natural fresh water resources pose serious constraints; desertification; air pollution from industrial and vehicle emissions; groundwater pollution from industrial and domestic waste, chemical fertilizers, and pesticides

JORDAN


Mediterranean Sea
LEB.
SYRIA
IRAQ
Golan Heights (Israeli occupied)
alignment approximate
Irbid
Az Zarqa'
AMMAN
West Bank*
Jordan River
Gaza Strip*
Dead Sea
Al Karak
ISRAEL
SAUDI ARABIA
Ma'ān
EGYPT
Al 'Aqabah
Gulf of Aqaba
0 50 100 km
0 50 100 mi
*Israeli occupied with current status subject to the Israeli-Palestinian Interim Agreement--permanent status to be determined through further negotiation.

JORDAN

- Location – northwest of Saudi Arabia
- Area –
  - *total:* 92,300 sq km
  - *water:* 329 sq km
  - *land:* 91,971 sq km
- Size – slightly smaller than Indiana
- Coastline – 26 km
- Natural Resources - phosphates, potash, shale oil

JORDAN

- Climate - mostly arid desert; rainy season in west (November to April)
- Terrain – mostly desert plateau in east, highland area in west; Great Rift Valley separates East and West Banks of the Jordan River
- Elevation Extremes –
  - *lowest point:* Dead Sea -408 m
  - *highest point:* Jabal Ram 1,734 m
- Environmental Issues - limited natural fresh water resources; deforestation; overgrazing; soil erosion; desertification


AL JAHRAH
KUWAIT
Persian
Gulf
AL AHMADI

KUWAIT

- Location – bordering the Persian Gulf, between Iraq and Saudi Arabia
- Area –
  - *total:* 17,820 sq km
  - *water:* 0 sq km
  - *land:* 17,820 sq km
- Size – slightly smaller than New Jersey
- Coastline – 499 km
- Natural Resources - petroleum, fish, shrimp, natural gas

KUWAIT

- Climate - dry desert; intensely hot summers; short, cool winters
- Terrain – flat to slightly undulating desert plain
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* unnamed location 306 m
- Environmental Issues - limited natural fresh water resources; some of world's largest and most sophisticated desalination facilities provide much of the water; air and water pollution; desertification

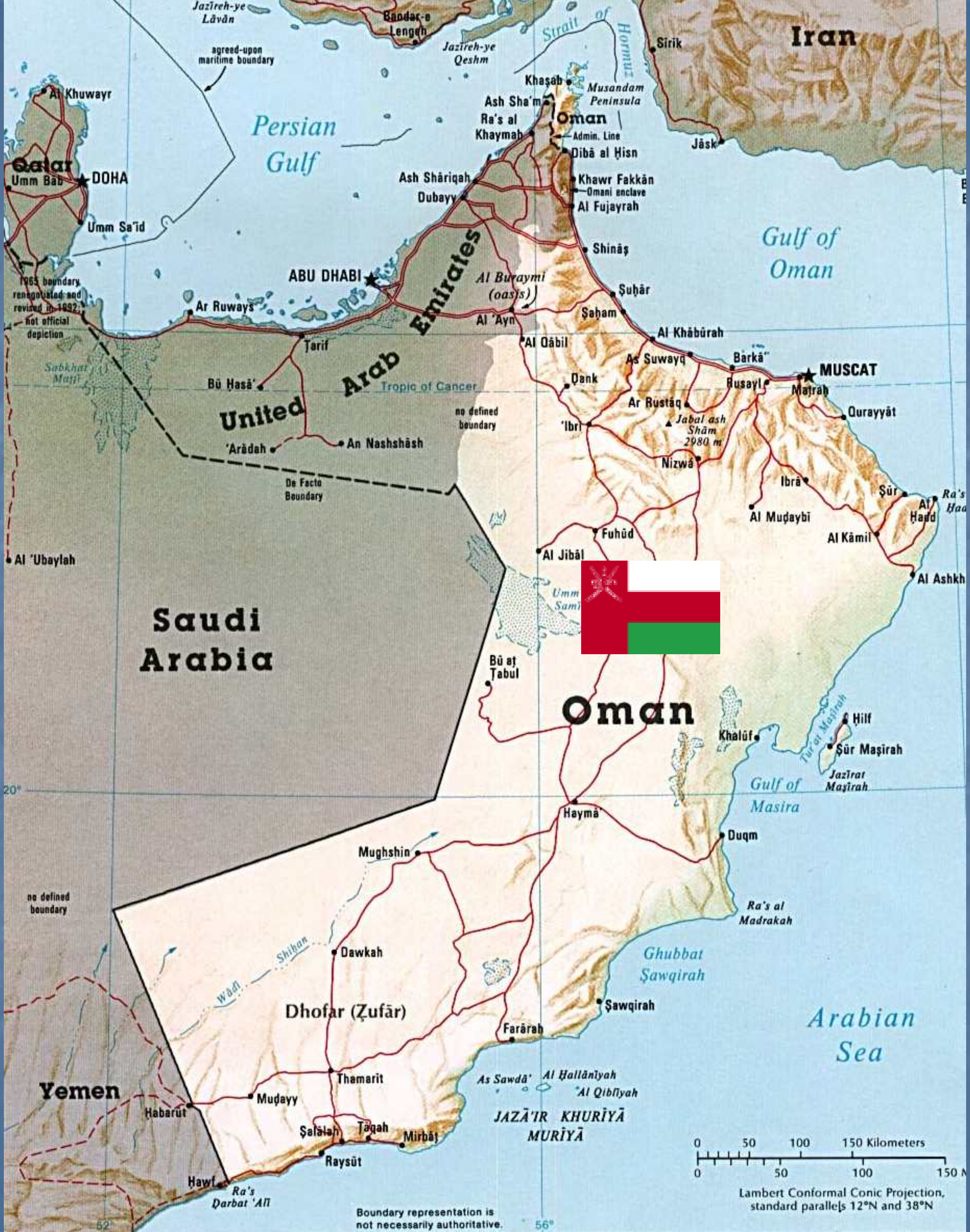
Base 505043 (544600) 2-82

LEBANON

- Location – bordering the Mediterranean Sea, between Israel and Syria
- Area –
  - *total:* 10,400 sq km
  - *water:* 170 sq km
  - *land:* 10,230 sq km
- Size – about 0.7 times the size of Connecticut
- Coastline – 225 km
- Natural Resources - limestone, iron ore, salt, water-surplus state in a water-deficit region, arable land

LEBANON

- Climate - Mediterranean; mild to cool, wet winters with hot, dry summers; Lebanon mountains experience heavy winter snows
- Terrain – narrow coastal plain; El Beqaa (Bekaa Valley) separates Lebanon and Anti-Lebanon Mountains
- Elevation Extremes –
  - *lowest point:* Mediterranean Sea 0 m
  - *highest point:* Qurnat as Sawda' 3,088 m
- Environmental Issues - deforestation; soil erosion; desertification; air pollution in Beirut from vehicular traffic and the burning of industrial wastes; pollution of coastal waters from raw sewage and oil spills



Iran
Persian Gulf
Gulf of Oman
Qatar
DOHA
ABU DHABI
United Arab Emirates
Oman
MUSCAT
Saudi Arabia
Yemen
Gulf of Masira
Arabian Sea
Dhofar (Ẓufār)
Strait of Hormuz
Musandam Peninsula
Tropic of Cancer
De Facto Boundary
no defined boundary
Boundary representation is not necessarily authoritative.
Lambert Conformal Conic Projection, standard parallels 12°N and 38°N

OMAN

- Location – bordering the Arabian Sea, Gulf of Oman, and Persian Gulf, between Yemen and UAE
- Area –
  - *total:* 212,460 sq km
  - *water:* 0 sq km
  - *land:* 212,460 sq km
- Size – slightly smaller than Kansas
- Coastline – 2,092 km
- Natural Resources - petroleum, copper, asbestos, some marble, limestone, chromium, gypsum, natural gas

OMAN

- Climate - dry desert; hot, humid along coast; hot, dry interior; strong southwest summer monsoon (May to September) in far south
- Terrain – central desert plain, rugged mountains in north and south
- Elevation Extremes –
  - *lowest point:* Arabian Sea 0 m
  - *highest point:* Jabal Shams 2,980 m
- Environmental Issues - rising soil salinity; beach pollution from oil spills; very limited natural fresh water resources


STATE OF QATAR
RAS RAKKAN
AL RUWAIS
MADINAT AL SHAMAL
AL KHUWAIR
FUWAIRAT
AL ZUBARA
HUWAILAT
RAS LAFFAN
AL GHUWAIRIYAH
AL KHOR
HAWAR ISLANDS
DUKHAN
AL SHAHANIYAH
DOHA
UMM BAB
AL WUKAIR
AL WAKRAH
MESSAIEED
AL KHARRARAH
DOHAT SALWA
ABU SAMRA
N
0 10 20
km

QATAR

- Location – peninsula bordering the Persian Gulf and Saudi Arabia
- Area –
  - *total:* 11,437 sq km
  - *water:* 0 sq km
  - *land:* 11,437 sq km
- Size – slightly smaller than Connecticut
- Coastline – 563 km
- Natural Resources - petroleum, natural gas, fish

QATAR

- Climate - arid; mild, pleasant winters; very hot, humid summers
- Terrain – mostly flat and barren desert covered with loose sand and gravel
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* Qurayn Abu al Bawl 103 m
- Environmental Issues - limited natural fresh water resources are increasing dependence on large-scale desalination facilities


ISRAEL
GAZA STRIP
WEST BANK
SYRIAN DESERT
IRAQ
IRAN
JORDAN
An Nabk
Turayf
'Ar'ar
Sakākah
Al Jawf
Rafḥah
KUWAIT
Al Bi'r
AN NAFŪD
Ḥafar al Bāṭin
Persian Gulf
Tabūk
Ra's al Khafjī
Strait of Tiran
Ḥā'il
Taymā'
Ḍubā
Al Jubayl
Ras Tanura
Strait of Hormuz
Al Wajh
AL ḤIJĀZ
Buraydah
Az Zilfī
Ad Dammām
OMAN
Abqaiq
'Unay
BAHRAIN
Umm Lujj
Mubarraz
QATAR
Gulf of Oman
Al Hufūf
Medina
Yanbu' al Baḥr
Ad Dav
UNITED ARAB EMIRATES
EGYPT
'Afīf
RIYADH
Badr Ḥunayn
Al Ḥarīq
SAUDI ARABIA
Rābigh
Ẓalim
NAJD
Jiddah
Mecca
Al Khurmah
Rumāḥ
Aṭ Ṭā'if
Turabah
RUB' AL KHALI
Al Līth
As Sulayyil
OMAN
Al Qunfudhah
SUDAN
Khamīs Mushayṭ
Abhā
Salwá
Abā as Su'ūd
Najrān
Farasan Is.
Jīzān
YEMEN
Arabian Sea
Red Sea
ERITREA

SAUDI ARABIA

- Location – bordering the Persian Gulf and the Red Sea, north of Yemen
- Area –
  - *total:* 1,960,582 sq km
  - *water:* 0 sq km
  - *land:* 1,960,582 sq km
- Size – slightly more than one-fifth the size of the US
- Coastline – 2,640 km
- Natural Resources - petroleum, natural gas, iron ore, gold, copper

SAUDI ARABIA

- Climate - harsh, dry desert with great temperature extremes
- Terrain – mostly uninhabited, sandy desert
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* Jabal Sawda' 3,133 m
- Environmental Issues - desertification; depletion of underground water resources; the lack of perennial rivers or permanent water bodies has prompted the development of extensive seawater desalination facilities; coastal pollution from oil spills

SYRIA


0 50 100 km
0 50 100 mi
TURKEY
Tigris
Aleppo
Al Ḥasakah
Ar Raqqah
Buḥayrat al Asad
Euphrates
Latakia
Jablah
Bāniyās
Med. Sea
Tarṭūs
Ḥamāh
Dayr az Zawr
Ḥimṣ
Tadmur
LEB.
IRAQ
DAMASCUS
Mount Hermon
Al Qunayṭirah
As Suwaydā'
alignment approximate
Golan Heights (Israeli occupied)
JORDAN
SAU. AR.

SYRIA

- Location – bordering the Mediterranean Sea, between Lebanon and Turkey
- Area –
  - *total:* 185,180 sq km
  - *note:* includes 1,295 sq km of Israeli-occupied territory
  - *water:* 1,130 sq km
  - *land:* 184,050 sq km
- Size – slightly larger than North Dakota
- Coastline – 193 km
- Natural Resources - petroleum, phosphates, chrome and manganese ores, asphalt, iron ore, rock salt, marble, gypsum, hydropower

SYRIA

- Climate - mostly desert; hot, dry, sunny summers (June to August) and mild, rainy winters (December to February) along coast; cold weather with snow or sleet periodically in Damascus
- Terrain – primarily semiarid and desert plateau; narrow coastal plain; mountains in west
- Elevation Extremes –
  - *lowest point:* unnamed location near Lake Tiberias -200 m
  - *highest point:* Mount Hermon 2,814 m
- Environmental Issues - deforestation; overgrazing; soil erosion; desertification; water pollution from raw sewage and petroleum refining wastes; inadequate potable water

TURKEY


BULGARIA
Black Sea
GEORGIA
AZER.
GR.
Bosporus
Istanbul
Sea of Marmara
Kocaeli
Samsun
Hopa
Trabzon
ARMENIA
Gemlik
Dardanelles
Bursa
ANKARA
Eskişehir
Balıkesir
Sivas
Erzurum
Mount Ararat
Euphrates
Lake Van
Van
IRAN
A N A T O L I A
Manisa
İzmir
Kayseri
Aegean Sea
Konya
Diyarbakır
Tigris
Kahramanmaraş
Gaziantep
Şanlıurfa
GREECE
Antalya
Adana
İçel
İskenderun
IRAQ
Mediterranean Sea
SYRIA
CYP.
0 50 100 km
0 50 100 mi

TURKEY

- Location – southeastern Europe and southwestern Asia (that portion of Turkey west of the Bosporus is geographically part of Europe), bordering the Black Sea, between Bulgaria and Georgia, and bordering the Aegean Sea and the Mediterranean Sea, between Greece and Syria
- Area –
  - *total:* 780,580 sq km
  - *water:* 9,820 sq km
  - *land:* 770,760 sq km
- Size – slightly larger than Texas
- Coastline – 7,200 km
- Natural Resources - antimony, coal, chromium, mercury, copper, borate, sulfur, iron ore, arable land, hydropower

TURKEY

- Climate - temperate; hot, dry summers with mild, wet winters; harsher in interior
- Terrain – high central plateau (Anatolia); narrow coastal plain; several mountain ranges
- Elevation Extremes –
  - *lowest point:* Mediterranean Sea 0 m
  - *highest point:* Mount Ararat 5,166 m
- Environmental Issues - water pollution from dumping of chemicals and detergents; air pollution, particularly in urban areas; deforestation; concern for oil spills from increasing Bosporus ship traffic

UNITED ARAB EMIRATES

UNITED ARAB EMIRATES

- Location – bordering the Gulf of Oman and the Persian Gulf, between Oman and Saudi Arabia
- Area –
  - *total:* 82,880 sq km
  - *land:* 82,880 sq km
  - *water:* 0 sq km
- Size – slightly smaller than Maine
- Coastline – 1,318 km
- Natural Resources - petroleum, natural gas

UNITED ARAB EMIRATES

- Climate - desert; cooler in eastern mountains
- Terrain – flat, barren coastal plain merging into rolling sand dunes of vast desert wasteland; mountains in east
- Elevation Extremes –
  - *lowest point:* Persian Gulf 0 m
  - *highest point:* Jabal Yibir 1,527 m
- Environmental Issues - lack of natural freshwater resources compensated by desalination plants; desertification; beach pollution from oil spills

YEMEN


SAUDI ARABIA
OMAN
Ḥabarūt
Ṣa 'dah
Jabal an Nabi Shu 'ayb
SANAA
Aṣ Ṣalīf
Say' ūn
Al Ghayḍah
Nishtūn
Sayḥut
Al Ḥudaydah
Ibb
Ta 'izz
Mocha
Abyān
Aden
Al Mukallā
Arabian Sea
Gulf of Aden
Socotra
Red Sea
ERIT.
DJI.
Bab el Mandeb
SOMALIA
ETH.
INDIAN OCEAN
0 100 200 km
0 100 200 mi
45
50
20
15
10

YEMEN

- Location – bordering the Arabian Sea, Gulf of Aden, and Red Sea, between Oman and Saudi Arabia
- Area –
  - *total:* 527,970 sq km
  - *land:* 527,970 sq km
  - *note:* includes Perim, Socotra, the former Yemen Arab Republic (YAR or North Yemen), and the former People's Democratic Republic of Yemen (PDRY or South Yemen)
  - *water:* 0 sq km
- Size – slightly larger than twice the size of Wyoming
- Coastline – 1,906 km
- Natural Resources - petroleum, fish, rock salt, marble, small deposits of coal, gold, lead, nickel, and copper, fertile soil in west

YEMEN

- Climate - mostly desert; hot and humid along west coast; temperate in western mountains affected by seasonal monsoon; extraordinarily hot, dry, harsh desert in east
- Terrain – narrow coastal plain backed by flat-topped hills and rugged mountains; dissected upland desert plains in center slope into the desert interior of the Arabian Peninsula
- Elevation Extremes –
  - *lowest point:* Arabian Sea 0 m
  - *highest point:* Jabal an Nabi Shu'ayb 3,760 m
- Environmental Issues - very limited natural fresh water resources; inadequate supplies of potable water; overgrazing; soil erosion; desertification


Black Sea
Caspian Sea
TURKMENISTAN
Ankara
TURKEY
Ashgabat
SYRIA
Tehran
LEBANON
Beirut
Baghdad
Damascus
Mediterranean Sea
ISRAEL
IRAN
AFG.
Amman
IRAQ
PALESTINE
Jerusalem
JORDAN
Cairo
KUWAIT
EGYPT
BAHRAIN
Persian Gulf
PAK.
QATAR
Riyadh
Abu Dhabi
United Arab Emirates
Muscat
SAUDI ARABIA
Red Sea
OMAN
Khartoum
SUDAN
YEMEN
Sanaa
Arabian Sea
Center for Defense Information, 2002

Militarily Important Vector-Borne Diseases with **Short** Incubation Periods (<15 days)

- Malaria
- Sand Fly Fever
- Dengue Fever
- Endemic Typhus
- Relapsing Fever (Louse-borne)
- Relapsing Fever (Tick-borne)
- Crimean-Congo Hemorrhagic Fever
- Boutonneuse Fever
- Tick-borne Encephalitis
- Q Fever
- Murine Typhus
- Plague
- West Nile Fever
- Sindbis Virus
- Other Arthropod-borne Viruses

Malaria

Drug-Resistant *P. falciparum* Malaria in the ME

- Iran
- Iraq
- Israel
- Oman
- Saudi Arabia
- UAE
- Yemen

MALARIA-ENDEMIC AREAS OF THE MIDDLE EAST

Sand fly Fever
(Papatasi fever, Three-day fever)

- Bahrain
- Cyprus
- Iran
- Iraq
- Israel
- Jordan
- Kuwait
- Lebanon
- Oman
- Qatar
- Saudi Arabia
- Syria
- Turkey
- United Arab Emirates
- Yemen

Sand fly Fever
(Papatasi fever, Three-day fever)

- Serological evidence that gerbils serve as reservoirs
- Principal reservoir mechanism appears to be transovarial transmission
- *Phlebotomus papatasi* is the primary vector – tends to be more rural and periurban in distribution – requires warm, humid microhabitats for larval development – animal burrows
- Some *Phlebotomus papatasi* are autogenous, during first gonotropic cycle
- *Phlebotomus sergentii* and *Sergentomyia* spp. are suspected vectors.

Dengue
(Breakbone fever, Dandy fever)

- *Aedes aegypti* – primary vector
- Between 40º N and 40º S latitude
- Epidemics coincide with the rainy season and high mosquito populations
- *Ae. aegypti* inhabits all of Middle East
- Most recent outbreak 1994 and 1995 in Saudi Arabia
- DHF also reported

Epidemic typhus

- Transmitted by human body louse, *Pediculus humanus*
- Infectious agent is the bacterium *Rickettsia prowazekii*
- Case fatality rates vary from 10% to 40% in the absence of specific therapy
- Fever, headache, and general pains followed by a rash that spreads from trunk to the entire body

Relapsing Fever (louse-borne)
(Epidemic relapsing fever)

- Transmitted by human body louse, *Pediculus humanus*
- Caused by the spirochete *Borrelia recurrentis*
- Primary febrile attack followed by an afebrile interval and one or more subsequent attacks of fever and headache
- Interval between attacks range from 5 to 9 days
- Mortality can reach 40% if untreated

ENDEMIC AREAS OF LOUSE-BORNE RELAPSING FEVER

Relapsing Fever (tick-borne)
(cave fever)

- Transmitted by soft ticks of the genus *Ornithodoros*
- Caused by the spirochete *Borrelia recurrentis*
- Sporadic cases are most often reported from Iran, Iraq, Israel, Jordan, Syria, Saudi Arabia, and Yemen

Relapsing Fever (tick-borne)
(cave fever)

- Primary vectors
  - *Ornithodoros erraticus* – Saudi Arabia, Israel
  - *O. tholozani* – Israel, Lebanon, Iran, Iraq, Jordan, Syria, Turkey
  - *O. savignyi* – Saudi Arabia, Yemen
  - *O. asperus* – Iran
- Secondary vectors
  - *O. erraticus* and *O. tholozani* – Iran

Crimean-Congo Hemorrhagic Fever

- A zoonotic disease caused by a tick-borne virus of the family Bunyaviridae
- Fever, headache, muscle pain and rash, followed by a hemorrhagic state of hepatitis
- Mortality rate can exceed 30%
- CCHF is wide spread in the Middle east, infecting domestic animals everywhere except the island of Cyprus
- Human outbreaks of CCHF have occurred in Kuwait, Iraq, and the UAE

Crimean-Congo Hemorrhagic Fever

- Primary human vectors – *Hyalomma rufipes, H. anatolicum anatolicum, H. anatolicum excavatum, H. truncatum, H. marginatum*
- Primary enzootic vectors – *H. dromedarii, H. impeltatum*
- Suspected zoonotic vectors – *Boophilus annulatus, Rhipicephalus sanguineus*
- Possible vectors – (Turkey) – *Ixodes ricinus, Rhipicephalus bursa, Dermacentor marginatus*

Boutonneuse Fever

(Mediterranean tick fever, Mediterranean spotted fever, Marseilles fever, African tick typhus, Kenya tick typhus, India tick typhus)

- Tick-borne typhus – caused by *Rickettsia conorii*
- Button-like lesions, 2 to 5 mm in diameter, that develop at tick attachment site
- With antibiotic treatment, fever lasts no more than 2 days
- Fatality rate very low, even without treatment

Boutonneuse Fever

- Principal vector – *Rhipicephalus sanguineus* – entire region

- Additional vectors –
  - *Hyalomma rufipes* – Iraq, Israel, Jordan, Lebanon, Oman, Saudi Arabia, Yemen
  - *Amblyomma variegatum* – southwest Saudi Arabia, Yemen
  - *R. turanicus* – Israel, Jordan, Lebanon
  - *R. appendiculatus* – only in the Asir District of southwest Saudi Arabia

Tick-borne Encephalitis (TBE)

- Caused by a complex of flaviviruses
  - Far Eastern TBE (Russian spring-summer encephalitis)
  - Central European TBE (biphasic meningoencephalitis, diphasic milk disease)

Tick-borne Encephalitis (TBE)

- Principal vector – *Ixodes ricinus* – Israel, Iran, Cyprus, Turkey

- Secondary vectors - *Dermacentor marginatus, Haemaphysalis punctata* – Iran, Turkey

Q Fever
(Query fever)

- Acute, self-limiting, febrile rickettsial disease caused by *Coxiella burnetti*
- Outbreaks of Q fever in humans have been traced to consumption of infected dairy products, contact with contaminated wool or hides, infected straw, and infected animal feces
- Fatality rate in untreated acute cases is <1%

Murine Typhus
(Flea-borne typhus, Endemic typhus, Shop typhus)

- Infectious agent – *Rickettsia typhi*
- Milder than *R. prowazekii*
- Clinical symptoms last up to 2 weeks in untreated cases
- Easily treated with antibiotics
- Absence of louse infestation, seasonal distribution, and sporadic occurrence differentiate it from epidemic typhus

DISTRIBUTION OF MURINE TYPHUS IN THE MIDDLE EAST

Murine Typhus

- Primary vectors
  - Oriental rat flea – *Xenopsylla cheopis*
  - Cat and dog fleas – *Ctenocephalides felis, C. canis*
- Secondary vector
  - Body louse - *Pediculus humanus*
- Maintenance vectors
  - Northern rat flea – *Nosopsyllus fasciatus*
  - Spiny rat louse – *Polyplax spinulosa*
  - Tropical rat mite – *Ornithonyssus bacoti*

Plague
(Pestis, Black death)

- A zoonotic bacterial disease involving rodents and their fleas – *Yersinia pestis*
- Easily treated with antibiotics (early)
- Untreated fatality rate 50%

ENZOOTIC FOCI OF PLAGUE IN THE MIDDLE EAST

West Nile Fever

- A mosquito-borne illness characterized by fever, headache, muscular pain, and rash
- *Flavivirus*
- Often asymptomatic
- Wide spread throughout the Middle East

West Nile Fever

- Primary vector – *Culex univittatus* – Kuwait, Iran, Iraq, Israel, Lebanon, Oman, Saudi Arabia, Turkey, Yemen

- Potential vectors – *An. coustani, Cx. antennatus, Cx. pipiens pipiens, Cx. P. molestus, Cx. perexiguus* – throughout region

- Possible zoonotic vector – *Ornithodoros capensis* – in colonial birds inhabiting islands in the Caspian Sea off the coast of Azerbaijan

Sindbis Virus

- Belongs to the genus *Alphavirus* in the family Togaviridae
- No fatal cases reported
- One of the most widely distributed of all known arboviruses
- Circulating in many parts of the Middle East

Sindbis Virus

- Suspected vectors – *Culex antennatus, Cx. pipiens* complex, *Cx. univittatus, An. pharoensis*

Other Arthropod-borne Viruses

- Many enzootic arboviruses are circulating in the Middle East but little is known about them
  - Tahyna virus - (Bunyaviridae, *Bunyavirus*, California group) (*An. hyrcanus, Cx. pipiens*)
  - Batai virus (Bunyaviridae, *Bunyavirus*, Bunyamwera group) (*Ae. communis* complex, Anophelines)
  - Bhanja viral infection – (tick-borne)
  - Karimabad virus (phlebotomine sand flies)
  - Salehabad virus (phlebotomine sand flies)
  - Teheran virus (*P. papatasi* sand flies)
  - Toscana virus (*P. perniciosus* sand flies)
  - Al Khumer hemorrhagic fever (tick-borne)
  - Rift Valley Fever (*Cx. Pipiens* complex, et. al.)

Militarily Important Vector-Borne Diseases with **Long** Incubation Periods (>15 days)

- Leishmaniasis
  - Cutaneous
  - Visceral
- Schistosomiasis
- Onchocerciasis
- Bancroftian Filariasis
- Lyme Disease

Leishmaniasis

- A disease caused by infection with protozoan parasites of the genus *Leishmania*
- Phlebotomine sand flies
  - Old World – *Phlebotomus*
- Cutaneous – (Baghdad boil, Jericho boil, Oriental sore)
- Visceral – (Kala-azar, Dum Dum fever)

ENDEMIC AREAS OF CUTANEOUS LEISHMANIASIS IN THE ME

ENDEMIC AREAS OF VISCERAL LEISHMANIASIS IN THE ME

Leishmaniasis

- Proven sand fly vector (*Le. major*) – *P. papatasi*
- Suspected vectors (*Le. major*) – *P. alexandri, P. ansarii, P. bergeroti, P. caucasicus, P. salehi*

- Incriminated vector (*Le. tropica*) – *P. sergenti*
- Suspected vectors (*Le. tropica*) – *P. chabaudi, P. saevus, P. sergenti*

Leishmaniasis

- Proven and Suspected vectors (*Le. Infantum*) – *P. brevis, P. halepensis, P. kandelakii, P. kryreniae, P. longiductus, P. neglectus, P. simici, P. tobbi, P. transcaucasicus*

- Proven vector (*Le. Donovani*) – *P. alexanri*
- Suspected vectors - (*Le. Donovani*) - *P. caucasicus, P. mongolensis*

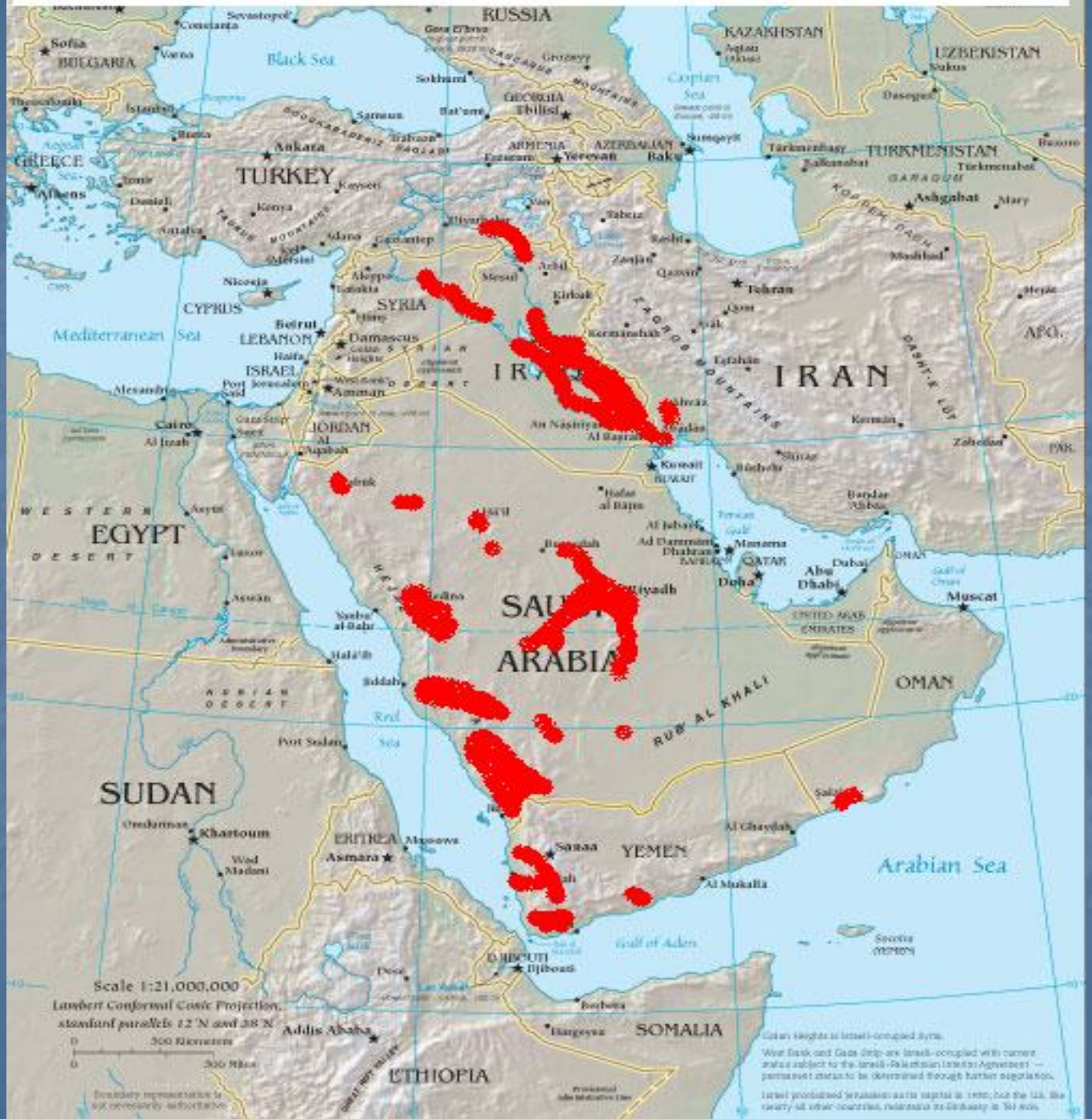
Schistosomiasis
(Bilharziasis, Snail fever)

- A disease caused by trematodes in the genus *Schistosoma*
- WHO considers five species of schistosomes significant (hepatic and intestinal)
  - Schistosoma mansoni
  - S. japonicum
  - S. mekongi
  - S. intercalatum
  - S. haematobium – (urinary)

Schistosomiasis

- 200 million persons infected worldwide
- *S. mansoni* and *S. haematobium* are endemic in the Middle East
- Except – Bahrain, Cyprus, Israel, Qatar

DISTRIBUTION OF SCHISTOSOMIASIS IN THE MIDDLE EAST



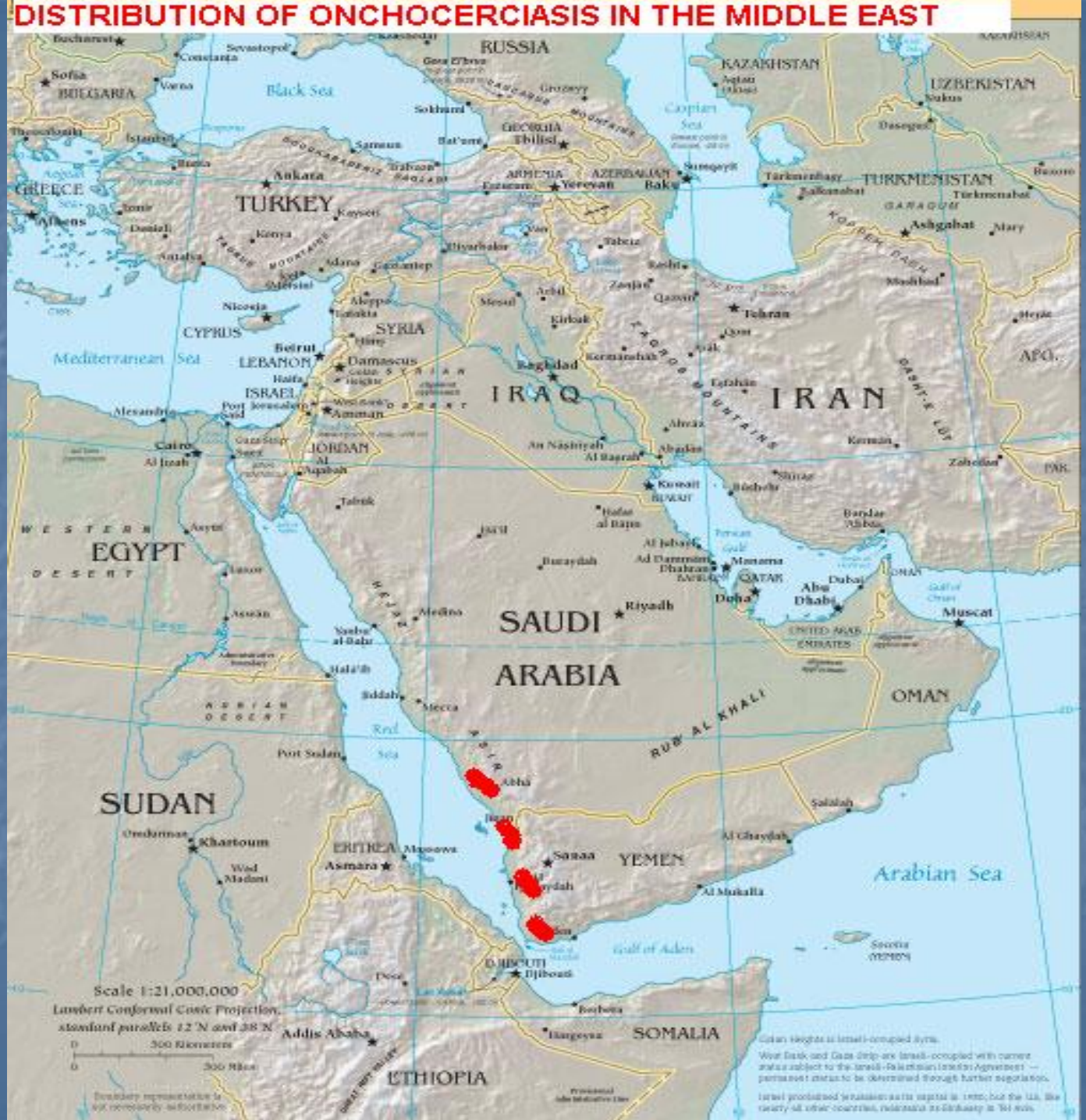
Schistosomiasis

- *Biomphalaria arabica*, *Bulinus beccarii, Bu. Wrighti,* and *Bi. Truncatus* are the intermediate hosts of schistosomes in the Middle East
- *S. mansoni* is associated with *Bi. Arabica*
- *S. haematobium* is associated with *Bu. beccarii, Bu. Wrighti, Bi. Truncatus*

Onchocerciasis
(River Blindness)

- A chronic, nonfatal disease in which adult worms form fibrous nodules in subcutaneous tissues
- The parasite is a filarial nematode worm, *Onchocerca volvulus*
- *O. fasciata,* occurs in camels but does not infect man
- Members of the *Sumulium damnosum* complex are the primary vectors (Black Fly)

DISTRIBUTION OF ONCHOCERCIASIS IN THE MIDDLE EAST



Bancroftian Filariasis

- Caused by the nematode *Wuchereria bancrofti*, which normally resides in the lymphatic system of infected humans
- Sporadic cases have been reported from Iran, Oman, Yemen, and southwestern Saudi Arabia
- Members of the *Culex pipiens* complex are the primary vector
- *Culex bitaeniorhynchus, Ae. aegypti,* and *An. arabiensis* are considered possible secondary vectors

DISTRIBUTION OF FILARIASIS IN THE MIDDLE EAST

Lyme Disease

- Also called Lyme borreliosis, tick-borne meningopolyyneuritis, erythema chronicum migrans, Lyme arthritis, and Barnwart's syndrome
- Causative agent is the spirochete bacterium *Borrelia burgdorferi*
- The prevalence of Lyme borreliosis in the Middle East is unclear
- Suspected in only Turkey and Israel
- Hard ticks - *Ixodes ricinus* – Israel, Iran, Cyprus, and Turkey

Other Diseases of Military Significance

- Leptospirosis
- Hantaviral Disease

Diarrheal Disease

- GI infections are principal disease threats in ME, both urban and rural
- Contaminated food, food preparation surfaces, utensils, water, ice
- Filth flies act as mechanical transmission for pathogens;
  - *Staphylococcus aureus*, *Clostridium perfringens*, *Bacillus cereus*, *Vibrio parahaemolyticus*, numerous serotypes of *Salmonella*, *Shigella* spp., *Campylobacter*, pathogenic strains of *Escherichia coli*, and hepatitis A and E, among other viral species
- Bacterial pathogens account for more than 75% of cases
- Resistance of enteric pathogens to commonly used antibiotics can complicate treatment

Noxious / Venomous Animals and Plants of Military Significance
ARTHROPODS

- Acari (ticks and mites)
- Araneae (spiders)
- Ceratopganidae (biting midges)
- Chilopoda & Diplopoda
- Cimicidae (bedbugs)
- Dipterans Causing Myasis
- Hymenoptera (ants, bees, wasps)

Noxious / Venomous Animals and Plants of Military Significance
ARTHROPODS

- Lipidoptera (urticating moths & caterpillars)
- Meloidae & Staphylinidae (blister beetles & Rove beetles)
- Scorpionida (scorpions)
- Simuliidae (black flies)
- Siphonaptera (fleas)
- Solpugida (sun spiders, wind scorpions)
- Tabanidae (horse flies & deer flies)

Noxious / Venomous Animals and Plants of Military Significance
VENOMOUS SNAKES

- Atractaspididae – burrowing vipers
- Viperidae – vipers, adders, asps
- Crotalidae – pit vipers
- Colubridae – blue krait, cobras
- Elapidae – nonvenomous - with 1 exception
- Hydrophiidae – sea snakes

Noxious / Venomous Animals and Plants of Military Significance
PLANTS

- Plants produce many clinical classes of contact dermal injury. These include mechanical injury, delayed contact sensitivity, contact urticaria, phototoxicity and photoallergy, primary chemical irritation, or some combination of these.

Noxious / Venomous Animals and Plants of Military Significance
PLANTS

- Many plants have fruiting bodies that appear edible or have attractive parts, such as castor bean. Some military personnel may be tempted to consume plants because that are used locally for various purposes. The cashew nut, *Anacardium occidentale*, is extremely toxic if eaten uncooked, and the resin in the plant can cause severe dermatitis.

Noxious / Venomous Animals and Plants of Military Significance
PLANTS

- Local lore may attribute medicinal qualities, psychotropic or aphrodisiac effects of native plants.

- Khat is a shrub cultivated in the ME for its leaves and berries, which are chewed or used as tea. It has euphoric and amphetamine-like effects.

SUMMARY

- Brief Description of Countries in the Middle East
- Militarily Important Vector-Borne Diseases with Short Incubation Periods (<15 days)
- Militarily Important Vector-Borne Diseases with Long Incubation Periods (>15 days)
- Other Diseases of Military Significance
- Noxious / Venomous Animals and Plants of Military Significance

REFERENCES

- Defense Pest Management Information Analysis Center, Armed Forces Pest Management Board, Walter Reed Army Medical Center, Washington, DC

Appendices

- Appendix A – Arthropod Species and their Distribution in the Middle East
  - A1 – Mosquitoes
  - A2 – Sand Flies
  - A3 – Ticks
  - A4 – Fleas
  - A5 – Scorpions
- Appendix B – Vector Ecology Profiles
  - B1 – Malaria Vectors
  - B2 – Ticks

Appendix A. Arthropod Species and their Distribution in the Middle East

A.1. Reported Distribution of Mosquitoes in the Middle East (+ = Present; ? = Uncertain)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
Aedes aegypti	+	?	+	+	+	?	+	+	+	+	+	+	+	?	+
Ae. annulipes													+		
Ae. caballus			+												+
Ae. caspius	+			+			+						+		+
Ae. communis				+							+		+		
Ae. detritus		+											+		
Ae. dorsalis													+		
Ae. echinus				+									+		
Ae. excrucians													+		
Ae. flavescens				+									+		
Ae. geniculatus				+									+		
Ae. grantii															+
Ae. lepidonotus				+									+		
Ae. mariae				+									+		
Ae. nigrocanus													+		
Ae. pulchritarsis			+										+		
Ae. refiki				+									+		+
Ae. rusticus													+		
Ae. vexans			+										+		
Ae. vittatus															+

A.1. Mosquitoes continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
Anopheles algeriensis			+	+	+	+		+				+	+		
An. apoci			+	+											
An. azaniae															+
An. claviger		+	+	+	+	+		+				+	+		
An. cinereus					+	+			+		+				+
An. coustani					+				+		+				+
An. culicifacies	+		+	+					+	+	+			+	+
An. demeloni															+
An. d'thali			+	+	+	+	?	+	+		+	+		+	+
An. fluviatilis	+		+	+			+		+		+				+
An. gambiae arabiensis											+				+
An. hyrcanus		+	+	+	+	+		+				+	+		
An. maculipennis			+	+							+	+	+		
An. marteri sogdianus		+	+	+	+	+		+				+	+		
An. martinius			+												
An. messeae													+		
An. moghulensis			+												
An. multicolor		+	+	+	+	+		+	+	+	+	+			+
An. paltrinierii									+						
An. pharoensis					+	+					+	+			+
An. plumbeus			+									+	+		
An. pretoriensis															+
An. pulcherrimus	+		+	+	+	?	+	+	+		+	+	+		
An. rhodesiensis rupicola					+	+		+	+		+	+			+
An. sacharovi		+	+	+	+	+		+				+	+		

A.1. Mosquitoes continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
An. sergentii			+	+	+	+		+	+	+	+	+			+
An. squamosus															+
An. stephensi	+		+	+			+		+		+			+	
An. subalpinus			+	+								+	+		
An. subpictus			+												
An. superpictus		+	+	+	+	+	?	+			+	+	+		
An. tenebrosus					+	+			+		+				
An. turkudi			+	+	+		+		+		+				+
Coquillettidia buxtoni					+							+			
Cq. Richardii												+			
Culex antennatus			+		+										+
Cx. arbieeni			+								+				+
Cx. bitaeniorhynchus			+												+
Cx. decens															+
Cx. deserticola			+								+	+	+		
Cx. duttoni															+
Cx. hortensis			+	+				+					+		
Cx. judaicus						+									
Cx. laticinctus			+	+	+			+	+		+	+	+		+
Cx. martinii													+		
Cx. mattinglyi											+				+
Cx. mimeticus			+					+			+	+	+		
Cx. modestus			+	+	+										
Cx. perexiguus			+	+	+			+	+		+	+	+		

A.1. Mosquitoes continued

Cx. pipiens molestus			+	?	+	?	?	+	?		+	?		?	?
Cx. pipiens pipiens	+	+	+	+	+	+	+	+	+	?	+	+	+	?	+
Cx. p. quinquefasciatus			+	+			+		+	+		+	+		
Cx. pseudovishnui			+												
Cx. pusillus			+	+	+						+	+	+		
Cx. saliburiensis															+
Cx. simpsoni															+
Cx. sinaiticus			+		+	+			+		+				+
Cx. sitiens			+						+		+		+	+	+
Cx. territans			+	+									+		
Cx. thallasius															+
Cx. theileri			+	+	+	+		+			+	+	+		+
Cx. tigripes											+				?
Cx. torrentium			+	+									+		
Cx. tritaeniorhynchus			+	+	+	+		+	+		+	+	+		+
Cx. univittatus			+	+	+	+	+	+	+		+	+	+		+
Culiseta annulata				+			+				+	+	+		
Cs. fumipennis													+		
Cs. longiareolata			+	+							+	+	+		+
Cs. morsitans					+								+		
Cs. subochrea				+											
Uranotaenia unguiculata			+	+			+				+	+			

A.2. Reported Distribution of Sand Flies in the Middle East (+ = Present; ? = Uncertain)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	U.A.E.	Yemen
Phlebotomus alexandrei		+	+	+	+	+	+	+	+		+	+	+	+	+
P. andrejevi			+												
P. ansarii			+	+											
P. arabicus				+							+				+
P. argentipes			+												
P. balcanicus			+										+		
P. bergeroti			+					+	+		+			+	+
P. brevis			+										+		
P. caucasicus			+										+		
P. chinensis arabicus															+
P. chinensis balcanicus			+	+				+				+	+		
P. chinensis longiductus			+												
P. davidi															+
P. duboscqi								+			+				+
P. eleanorae			+												
P. halepensis			+	+	+							+	+		
P. jacusieli			+		+			+				+	+		
P. kandelakii			+	+								+	+		
P. kazeruni			+			+	+				+				
P. keshishiani			+												
P. kryreniae		+											+		
P. langeroni orientalis											+				
P. laroussei													+		
P. major syriacus			+	+	+	+		+			+	+	+		

A.2. Sand flies continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	U.A.E.	Yemen
P. marismortui			+												
P. mascittii canaaniticus					+							+			
P. mascittii mascittii			+										+		
P. meruynae				+											
P. mesghallii			+												
P. mofidii			+												
P. mongolensis			+												
P. naqbenius											+				
P. nuri			+												
P. orientalis								+			+				+
P. palestinensis				+											
P. papatasi			+	+	+	+	+	+	+		+	+	+		+
P. perfiliewi galilaeus		+			+								+		
P. perfiliewi perfiliewi		+											+		
P. perfiliewi transcaucasicus			+	+											
P. perniciosus													+		
P. saevus											+				+
P. salehi			+												
P. saltiae								+							
P. sergenti		+	+	+	+	+		+	+		+	+	+		+
P. simici					+							+	+		
P. smirnovi			+												
P. syriacus								+				+	+		
P. tobbi		+	+	+	+							+	+		
P. transcaucasicus			+												
P. wenyoni			+	+									+		
P. zulfagarensis			+												

A.2. Sand flies continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	U.A.E.	Yemen
Sergentomyia adleri						+					+			+	
S. africana			+		+	+					+				
S. antennata			+		+	+	+				+			+	
S. babylonica				+											
S. bagdadis			+	+											
S. calcarata											+				
S. christophersi			+			+			+		+				
S. clydei			+	+	+		+				+			+	
S. dentata			+	+								+			
S. dolichopus											+				
S. dryfussi			+			+		+			+				+
S. fallax				+	+	+		+			+			+	+
S. grekovi			+												
S. hodgsoni				+											
S. iranica			+												
S. magna											+				
S. mervynae			+												
S. palestinensis			+	+	+						+				
S. pawlowskyi			+												
S. schwetzi											+				
S. sintoni			+	+											
S. sogdiana			+												
S. sonyae											+				
S. squamipleuris			+	+	+		+				+				
S. sumbarica			+												
S. taizi								+			+				+
S. theodori			+		+	+					+	+			
S. tiberiadis			+		+				+		+				

A.3. Reported Distribution of Ticks in the Middle East (+ = Present or Introduced)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
ARGASIDAE															
Argas boueti			+		+										
A. confusus					+										
A. hermanni			+								+				
A. persicus		+	+	+	+			+	+		+	+	+		+
A. reflexus			+		+							+	+		
A. streptopelia		+							+		+				
A. transgariepinus					+										
A. vespertilionis			+	+					+						
A. vulgaris			+												
Ornithodoros asperus			+	+											
O. canestrinii			+												
O. coniceps			+		+	+									
O. erraticus			+	+			+				+				
O. foleyi									+						
O. lahorensis			+	+	+							+	+		
O. muesebecki								+	+		+				+
O. procaviae					+										
O. salahi					+										
O. savignyi				+	+			+	+		+				+
O. tartakovskyi			+												
O. tholozani		+	+	+	+	+		+				+			

A.3. Ticks continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
IXODIDAE															
Amblyomma eburneum											+				
A. gemma					+						+				+
A. lepidum				+	+						+				
A. variegatum					+				+		+				+
Aponomma latum											+				+
Boophilus annulatus		+	+	+	+			+	+		+	+	+		+
B. decoloratus											+				
B. kohlsi				+	+	+					+	+			+
D. marginatus			+										+		
D. niveus			+										+		
D. reticulatus			+												
D. raskemensis			+												
Haemaphysalis adleri				+	+										
H. caucasica			+												
H. concinna			+										+		
H. erinacei			+	+							+	+	+		
H. indica			+						+						
H. inermis			+										+		
H. kashmirensis			+												
H. kopetdaghica			+												
H. leachi															+
H. longicornis											+				
H. parva			+	+								+			
H. punctata		+	+	+									+		

A.3. Ticks continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
H. sulcata		+	+	+	+						+	+	+		+
Hyalomma aegyptium		+	+	+	+			+				+	+		
H. arabica								+			+				+
H. anatolicum anatolicum		+	+	+	+			+	+		+	+	+	+	+
H. anatolicum excavatum		+	+	+	+		+	+			+	+	+	+	+
H. asiaticum			+	+											
H. detritum			+	+	+			+				+	+		
H. dromedarii			+	+	+	+		+	+		+	+	+		+
H. erythraeum								+			+				+
H. impeltatum			+	+	+			+	+		+	+	+	+	+
H. kumari			+												
H. marginatum		+	+	+	+	+	+	+			+	+	+		
H. marginatum turanicum		+	+	+							+		+		+
H. rhipicephaloides						+									
H. rufipes		+	+	+	+	+	+	+	+		+		+		+
H. schulzei			+	+	+						+	+			
H. truncatum											+				+
Ixodes arboricola					+										
I. canisuga			+												
I. crenulatus		+	+												
I. eldaricus			+	+	+										
I. gibbosus		+											+		+
I. hoogstraali								+	+						+
I. kaiseri					+							+			

A.3. Ticks continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
I. redikorzevi					+										
I. ricinus		+	+		+								+		
I. simplex					+										
I. vespertilionis			+		+								+		
Rhipicephalus appendiculatus											+				
R. bursa		+	+	+	+							+	+		
R. camicasi											+				
R. evertsi								+			+				+
R. guilhoni											+				
R. kochi											+				
R. leporis			+	+											
R. pravus											+				
R. pulchellus											+				
R. punctatus											+				
R. sanguineus		+	+	+	+		+	+	+		+	+	+		+
R. senegalensis											+				
R. simus								+			+				+
R. sulcatus											+				
R. turanicus		+	+	+	+				+		+	+			

A.4. Reported Distribution of Fleas in the Middle East (+ = Present; ? = Uncertain)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
CERATOPHYLLIDAE															
Amalaraeus penicilliger kratochvili													+		
A. steineri													+		
Callopsylla caspia caspia			+					+				+			
C. saxatilis			+	?				?				?	+		
C. tiflovi			+												
Ceratophyllus columbae													+		
C. fringillae			+		+			+					+		
C. gallinae			+												
C. hirundinis			?	?				+				?	+		
C. sciurorum sciurorum								+					+		
C. spinosus			+										?		
Citellophilus simplex													+		
C. transcaucasicus													+		
C. trispinus			+												
Dasypsyllus gallinulae gallinulae													+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
Megabothris turbidus													+		
Myoxopsylla dryomydis													+		
M. jordani			+										+		
M. laverani					+			+			+				
Nosopsyllus baltazardi			+												
N. bunni				+											
N. consimilis													+		
N. durii				+				+					+		
N. fasciatus	?	+	+	+	?	?	?	?	?	?	?	?	+		
N. geneatus						+					+				
N. henleyi israelicus		+			+						+				
N. iranus attenuatus			+	+	+	+		+			+	+	+		
N. iranus theodori			+		+	+					+	+			
N. laeviceps gorganus			+										?		
N. londiniensis londiniensis		?	+		+	+		+					+		
N. medus			+	+											
N. mikulini			+												
N. philipovi			+												
N. pringlei			+	+		?					+				
N. pumilionis				+	+	+									
N. sarinus aryanus			+				+								

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
N. sarinus parthius			+										+		
N. sarinus sarinus			+										+		
N. sinaiensis					?						+				
N. sincerus					+										
N. tersus tersus			+												
N. theodori				+	+	+					+	+			
N. turkmenicus			+												
N. vlasovi			+												
N. ziarus			+												
Oropsylla tapina													+		
Paraceras melis melis			+		?			+				+	+		
COPTOPSYLLIDAE															
Coptopsylla bairamaliensis			+												
C. iranica			+												
C. joannae			+	?	+	+					+	+			
C. lamellifer dubinini			+												
C. lamellifer lamellifer			+												
C. lamellifer rostrata			+												
C. mesghalii			+												
C. mofidii			+												
C. smiti				+											

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
HYSTRICHOPSYLLIDAE															
Ctenopthalmus allousei				+	+			+				+			
C. bifidatus													+		
C. bithynicus													+		
C. bureschi anatolicus													+		
C. chionomydis													+		
C. congener nadimi			+												
C. congener tenuistigmatus					+										
C. coniunctus													+		
C. contiger													+		
C. costai					+			+							
C. dolichus kurdensis			+												
C. euxinicus													+		
C. fissurus													+		
C. fransmiti													+		
C. friedericae													+		
C. harputus													+		
C. hypanis riciensis													+		
C. inornatus													+		
C. iranus persicus			+												
C. levanticus								+					+		
C. proximus													+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
C. reconditus													+		
C. rettigi smiti			+												
C. rostigayevi													+		
C. secundus								+					+		
C. spiniger													+		
C. stirps													+		
C. tibarenus													+		
C. turcicus													+		
Doratopsylla dampfi dampfi													+		
Epitedia wenmanni													+		
Hystrichopsylla orientalis guentheri													+		
H. satunini													+		
Neopsylla pleskei ariana			+												
N. setosa spinea													+		
N. teratura rhagesia			+												
Paleopsylla alpestris													+		
P. caucasica													+		
P. incisa													+		
P. obliqua													+		
P. obtusa													+		
Rhadinopsylla bivirgis			+												
R. golana					+										
R. hoogstraali								+							

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
R. masculana masculana					+										
R. syriaca			+					+				+			
R. ucrainica			+												
Stenoponia tripectinata irakana			+	+									+		
S. tripectinata			+	+	+						+		+		
S. vlasovi			+												
Typhloceras poppei poppei													+		
Wagnerina schelkovnikovi			+												
ISCHNOPSYLLIDAE															
Chiropteropsylla brockmani			+	+											
Ischnopsyllus elongatus			+					+							
I. octactenus			+												
I. peridolius													+		
Nycteridopsylla longiceps													+		
Rhinolophopsylla unipectinata unipectinata				+	+			+					+		+
LEPTOPSYLLIDAE													+		
Amphipsylla argoi			+												
A. parthiana			+												
A. rossica rossica			+					+					+		
A. schelkovnikovi			+												
A. socia													+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
HYSTRICHOPSYLLIDAE															
Ctenopthalmus allousei				+	+			+				+			
C. bifidatus													+		
C. bithynicus													+		
C. bureschi anatolicus													+		
C. chionomydis													+		
C. congener nadimi			+												
C. congener tenuistigmatus					+										
C. coniunctus													+		
C. contiger													+		
C. costai					+			+							
C. dolichus kurdensis			+												
C. euxinicus													+		
C. fissurus													+		
C. fransmiti													+		
C. friedericae													+		
C. harputus													+		
C. hypanis riciensis													+		
C. inornatus													+		
C. iranus persicus			+												
C. levanticus								+					+		
C. proximus													+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
C. reconditus													+		
C. rettigi smiti			+												
C. rostigayevi													+		
C. secundus								+					+		
C. spiniger													+		
C. stirps													+		
C. tibarenus													+		
C. turcicus													+		
Doratopsylla dampfi dampfi													+		
Epitedia wenmanni													+		
Hystrichopsylla orientalis guentheri													+		
H. satunini													+		
Neopsylla pleskei ariana			+												
N. setosa spinea													+		
N. teratura rhagesia			+												
Paleopsylla alpestris													+		
P. caucasica													+		
P. incisa													+		
P. obliqua													+		
P. obtusa													+		
Rhadinopsylla bivirgis			+												
R. golana					+										
R. hoogstraali								+							

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
R. masculana masculana					+										
R. syriaca			+					+				+			
R. ucrainica			+												
Stenoponia tripectinata irakana			+	+									+		
S. tripectinata			+	+	+						+		+		
S. vlasovi			+												
Typhloceras poppei poppei													+		
Wagnerina schelkovnikovi			+												
ISCHNOPSYLLIDAE															
Chiropteropsylla brockmani			+	+											
Ischnopsyllus elongatus			+					+							
I. octactenus			+												
I. peridolius													+		
Nycteridopsylla longiceps													+		
Rhinolophopsylla unipectinata unipectinata				+	+			+					+		+
LEPTOPSYLLIDAE													+		
Amphipsylla argoi			+												
A. parthiana			+												
A. rossica rossica			+					+					+		
A. schelkovnikovi			+												
A. socia													+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
Caenopsylla laptevi			+					+			+				
Ctenopsylla rufescens			+												
Leptopsylla algira				+	+										
L. segnis		?	+	?	+	?		+				+	+		+
L. taschenbergi			+					+					+		
Mesopsylla apscheronica													+		
M. eucta eucta			+	?											
M. tuschkan mesa			+												
M. tuschkan tuschkan			+												
Ophthalmopsylla volgensis arnoldi			+										+		
O. volgensis impersia			+												
O. volgensis intermedia			+												
O. volgensis palestinica					+	+					+	+			
Paradoxopsyllus grenieri			+												
P. microphthalmus			+												
Peromyscopsylla bidentata risea												+			
P. silvatica												+			
P. tikhomirovae			+												
Phaenopsylla tiflovi			+												
PULICIDAE															
Archaeopsylla erinacei erinacei					?	+		+				+	+		

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
Ctenocephalides arabicus					+			+							+
C. canis.	?	+	+	+	+	?	+	+	+	?	+	?	+	?	+
C. felis felis	+	+	+	+	+	?	+	+	+	+	+	+	+	+	+
C. felis orientis			+												
Echidnophaga gallinacea	?	?	+	?	+	?	?	?	?	?	+	+	?	?	+
E. murina					+			+					+		
E. oschanini			+												
E. popovi			+		+			+			+				+
Parapulex chephrenis		+	+		+						?				
Pulex irritans		+	+	+	+	+	?	?			+	+	?		+
Synosternus cleopatrae chleopatrae			+		+	+			+		+				+
Synosternus pallidus			+	+	+	+	+		+		+	+			+
Xenopsylla astia			+	+					+		+				?
X. bantorum															+
X. brasiliensis											+				
X. buxtoni			+												
X. cheopis	?	+	+	+	+	+	+	+	+	+	+	+	+	?	+
X. conformis			+	+	+	+					+	+			
X. dipodilli					+	+					+				+
X. gerbilli gerbilli			+	?	?	?									
X. hussaini			+												
X. nubica			+	+	+	+			+		+				+

A.4. Fleas continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
X. nuttalli			+												
X. persica			+												
X. ramesis					+	+		+				+	+		
X. regis															+
VERMIPSYLLIDAE															
Chaetopsylla globiceps			+			+		+							
C. hyaena			+												
C. korobkovi			+												
C. rothschildi								+							
C. trichosa aviceni			+										+		

A.5. Reported Distribution of Scorpions in the Middle East (+ = Present; ? = Uncertain)

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
BUTHIDAE															
Androctonus amoreuxi			+		+										
A. a. baluchicus			+												
A. a. hebraeus					+										
A. australis									+		+				+
A. bicolor					+							+			
A. crassicauda	+		+	+	+	+	+		+		+	+	+	+	+
A. finitimus			+												
Apistobuthus pterygocercus			+						+	+	+			+	+
Babycurus zambonellii															+
Birulatus haasi						+									
Buthacus arenicola					+										
B. leptochelys			+	+	+	+		+			+	+			
B. tadmorensis	+		+	?	+						+	+			
B. t. nigroaculeatus	+														
B. t. tadmorensis			+									+			
B. t. yotvatensis			+	?	+						+	+			
Butheolus gallagheri									+						
B. thalassinus			?												+
Buthus occitanus		?			+										
Compsobuthus acutecarinatus				+		+			+		+	+			+
C. a. acutecarinatus				+											+
C. a. arabicus									+		+				
C. a. jordanensis						+						+			

A.5. Scorpions continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
C. brevimanus															+
C. maindroni									+						+
C. manzonii															+
C. mathiesseni			+	+									+		
C. rugulosus			+												
C. vachoni															+
C. werneri				+	+	+					+				+
C. w. carmelitis					+										
C. w. judaicus				+	+										
C. w. longipalpis					+	+									
C. w. werneri					+						+				+
Hottentotta alticola			+												
H. jayakari									+						+
H. judaicus					+	+		+				+	+		
H. saulcyi			+	+											
H. scaber				+											
H. schach			+	+											
Kraepelinia palpator			+												
Leiurus quinquestriatus					+	+		+			+	+			+
Liobuthus kessleri			+												
Mesobuthus agnetis			+												
M. caucasicus			+	+									+		
M. eupeus			+	+									+		
M. gabrielis			+												
M. gibbosus		+						+				+	+		
M. pietschmanni			+												

A.5. Scorpions continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
M. zarudnyi			+												
Microbuthus pusillus															+
Neohemibuthus kinzelbachi			+												
Odontobuthus doriae			+												
O. odonturus			+												
Orthochirus glabrifrons									+						
O. innesi											+				
O. scrobiculosus			+	+	+	+									
O. s. melanurus			+												
O. s. mesopotamicus				+											
O. s. negebensis					+	+									
O. s. persa			+												
O. s. scrobiculosus			+												
Parabuthus liosoma											+				+
Vachoniolus globimanus									+					+	
V. minipectinubus											+				
DIPLOCENTRIDAE															
Nebo flavipes															+
N. franckei									+						
N. grandis															+
N. henjamicus			+												
N. hierichonticus					+	+					+				
N. omanensis									+						
N. poggesii															+
N. whitei									+						

A.5. Scorpions continued

	Bahrain	Cyprus	Iran	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Syria	Turkey	UAE	Yemen
N. yemenensis															+
EUSCORPIIDAE															
Euscorpius germanus													+		
E. italicus													+		
E. mingrelicus													+		
ISCHNURIDAE															
Habibiella gaillardi			+												
Hemiscorpius arabicus											+				+
H. lepturus			+	+											
H. maindroni									+						
H. persicus			+												
IURIDAE															
Calchas nordmanni													+		
Iurus asiaticus													+		
SCORPIONIDAE															
Pandinus arabicus															+
P. percivali															+
Scorpio maurus			+	+	+	+	+	+			+	+	+		+
S. m. arabicus															+
S. m. fuscus					+			+			+	+	+		
S. m. kruglovi				+							+	+			
S. m. palmatus					+	+									
S. m. propinquus												+			
S. m. testaceous				+											
S. m. townsendi			+												
S. m. yemenensis															+

Appendix B. Vector Ecology Profiles

Appendix B.1. Vector Ecology Profiles of Malaria Vectors in the Middle East.

Species	Larval Habitats	Feeding Behavior	Resting Behavior	Flight Behavior
Anopheles gambiae arabiensis	Pools, borrow pits, rice fields, hoofprints.	Bites man and other animals, indoors and outdoors.	Rests indoors or outdoors after feeding.	Strong flier; specific flight range unknown.
An. claviger	Wells and cisterns.	Bites man and other animals, indoors and outdoors.	Rests indoors after feeding.	Short-range flier, specific range unknown.
An. culicifacies	Pools with partial sun and without emergent vegetation.	Prefers domestic animals. Bites man indoors and outdoors. Feeds through the night. Peak biting by 2400h.	Rests indoors or outdoors after feeding.	Information not available.
An. d'thali	Stagnant stream pools, brackish swamps, flowing drains.	Bites indoors and outdoors. Peak biting 2000-2100h.	Usually rests indoors after feeding.	Information not available.
An. fluviatilis	Stream pools and margins of rocky streams, with or without vegetation. Favors seepage from rice fields.	Aggressively bites man and domestic animals, indoors and outdoors.	Rests indoors or outdoors after feeding.	Short range flier, range probably <2km.
An. maculipennis	Fresh or brackish marshes, swamps, or rice fields.	Bites man and domestic animals.	Rests outdoors after feeding.	No information available.
An. pharoensis	Marshes, swamps, and rice fields. Favors emergent vegetation.	Bites man and domestic animals, indoors and outdoors.	Rests outdoors after feeding.	Strong flier; 10km or more.
An. pulcherrimus	Streams, stream pools, rice fields, date palm irrigation plots.	Prefers cattle, primarily biting outdoors before 2400h.	Rests indoors or outdoors after feeding.	No information available.
An. sacharovi	Grassy pools of fresh or brackish water. Often in coastal regions.	Bites man and other animals, indoors and outdoors.	Rests in human or animal shelters after feeding.	Strong flier; 10 km or more.
An. sergentii	Springs, date palm, and rice irrigation plots.	Bites man and other animals, indoors and outdoors.	Rests in human dwellings or caves.	Moderate flight range; may exceed 5km.

B.1. Malaria vectors continued

Species	Larval Habitats	Feeding Behavior	Resting Behavior	Flight Behavior
An. stephensi	Cisterns, borrow pits, artificial water containers, and ground pools.	Bites man and other animals, indoors and outdoors.	Rests indoors after feeding.	Rarely flies >0.5km from larval habitat.
An. superpictus	Clear, sunlit water, usually without vegetation.	Bites man and other animals, indoors and outdoors.	Rests in human dwellings, animal shelters, or caves.	Short to medium range flier; rarely flies >5km from larval habitat.

Appendix B.2. Vector Ecology Profiles of Ticks in the Middle East.

Species	Geographic Distribution	Potential Hosts	Disease Transmission	Bionomics/Habitat Information
Amblyomma variegatum	Oman, Yemen, possibly southwest Saudi Arabia.	Adults and immatures: sheep and cattle.	A suspect CCHF vector.	A 1-host tick. Species introduced from Africa, on cattle.
Boophilus annulatus	Throughout the Middle East.	Adults and immatures: cattle, sheep, rarely horses and man.	A minor CCHF vector.	A 1-host tick. All stages of the life cycle are generally spent on cattle. After feeding and mating, females rest up to a month before laying eggs. Life cycle <1 year.
Dermacentor marginatus	Turkey.	Adults: sheep, cattle, dogs, deer, humans. Immatures: rodents, hares, foxes, shrews.	TBE, sometimes CCHF.	A 3-host tick. Inhabits a wide range of biotopes, such as shrubby growth, forests and steppes. Resists desiccation. May diapause on its host. Lays huge number of eggs – up to 6,200.
Haemaphysalis punctata	Turkey.	Adults: cattle, horses, camels, and goats. Immatures: birds and hares.	TBE vector.	A 3-host tick. Often attaches in the groin or neck area. Larvae quest passively for birds in grassy areas. Somewhat resistant to aridity. In shrubs, forests or pastures.
Hyalomma anatolicum anatolicum	Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, Syria, Turkey, UAE, Yemen.	Adults: camels, sheep, goats, cattle, dogs, sometimes humans. Immatures: rodents (esp. gerbils), hares, birds.	Good vector of CCHF. Transovarial transmission occurs.	A 3-host tick. Dispersed widely from steppes and deserts east of Caspian Sea along caravan and cattle routes. Ticks often concentrate in feedlots. Nymphs feed on host's ears. Species often is active in winter months. Aggressive host-seeker; resists climatic extremes and aridity.
H. a. excavatum	Cyprus, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, UAE, Yemen.	Adults: cattle, camels, sometimes humans. Immatures: rodents (esp. gerbils), hares, birds.	Good vector of CCHF. Transovarial transmission occurs.	A 3-host tick. Immatures parasitize small mammals. Species remains active in winter in warmer regions. Resists temperature and humidity extremes well.
H. dromedarii	Iran, Iraq, Oman, Saudi Arabia, Yemen.	Adults: camels, goats, dogs. Immatures: rodents (esp. gerbils), hares, birds.	A zoonotic vector of CCHF. Transovarial transmission occurs.	A 2- or 3-host tick, depending on host. Immatures feed on a wide range of small mammals and sometimes lizards. Bionomics similar to other *Hyalomma* species.

B.2. Ticks continued

Species	Geographic Distribution	Potential Hosts	Disease Transmission	Bionomics/Habitat Information
H. impeltatum	Iraq, Israel, Jordan, Lebanon, Oman, Saudi Arabia, Syria, UAE, Yemen.	Adults: camels, cattle, sheep, dogs. Immatures: rodents, gerbils, hares, birds.	A zoonotic vector of CCHF. Transovarial transmission occurs.	A 2-host tick. Immatures feed on small animals. Inhabits semi-desert, savanna, and steppe biotopes.
H. marginatum marginatum	Iraq, Kuwait, Saudi Arabia, Turkey.	Adults: cattle, camels, sheep, dogs, humans. Immatures: rodents (esp. gerbils), hares, birds.	Good vector of CCHF. Transovarial transmission occurs. Transmits boutonneuse fever.	A 2-host tick. Adults quest aggressively from grass or rodent burrows. Feeding lasts 6-12 days, then females oviposit 1000's of eggs. Resists climatic extremes well.
H. marginatum turanicum	Iran, Iraq, Saudi Arabia.	Adults: cattle, camels, sheep, rarely humans. Immatures: rodents (esp. gerbils), hares, birds.	Good vector of CCHF. Transovarial transmission occurs.	A 2-host tick. Bionomics similar to *H. marginatum*.
H. rufipes	Iraq, Israel, Jordan, Lebanon, Oman, Saudi Arabia, Syria, Yemen.	Adults: camels, dogs, cattle, sometimes humans. Immatures: rodents (esp. gerbils), hares, birds.	Good vector of CCHF. Transovarial transmission occurs regularly. Transmits boutonneuse fever.	A 2-host tick, whose females oviposit after dropping from the host and die soon afterward. Females feed for 6-12 days. Species resists drought, cold, and heat. Distributed by birds along caravan routes.
H. truncatum	Yemen.	Adults: large herbivores, dogs, sometimes man. Immatures: rabbits, calves.	A good CCHF vector. Transovarial transmission occurs.	A 2-host tick. Immature stages parasitize ground-dwelling birds. Otherwise similar to other *Hyalomma* species.
Ixodes ricinus	Cyprus, Iran, Israel, Turkey.	Adults: sheep, cattle, deer, foxes, man. Immatures: rodents, hares, hedgehogs, foxes, dogs, man.	Principal vector of Lyme disease & TBE. Rarely vectors CCHF.	A 3-host tick. Ranges widely in moist, dense, forest biotopes. Intolerant of desiccation. Life cycle requires 2-4 years. Diapauses during winter. Females lay up to 2300 eggs.
Ornithodoros asperus	Iran.	Not known.	Vectors tick-borne relapsing fever.	Multi-host soft tick. Found in caves, huts, cabins, or stables. Rest of bionomics thought similar to *O. erraticus*.
O. erraticus	Iran, Iraq, Israel, Lebanon, Saudi Arabia, Syria, Turkey.	Adults: camels, swine, dogs, donkeys, sometimes humans. Immatures: gerbils and other rodents.	Vectors tick-borne relapsing fever.	Multi-host soft tick. Feeds quickly (1-2 hours), usually at night. Usually has 3-4 immature instars. Females mate and may live several years without a bloodmeal. Often lives in rodent burrows.

B.2. Ticks continued

Species	**Geographic Distribution**	**Potential Hosts**	Disease Transmission	Bionomics/Habitat Information
O. tholozani	Iran, Iraq, Israel, Lebanon, Saudi Arabia, Syria, Turkey.	Adults: camels, sheep, rarely humans. Immatures: unknown.	Vectors tick-borne relapsing fever.	Multi-host soft tick. Found in caves, huts, cabins, or stables. Rest of bionomics similar to *O. erraticus*.
Rhipicephalus appendiculatus	Southwest Saudi Arabia.	Adults: cattle, sheep. Immatures: rodents, hedgehogs, hares.	Transmits boutonneuse fever.	A 3-host tick. Introduced from Africa. Requires a humid environment. Females lay hundreds of eggs in dens of hosts.
R. bursa	Turkey.	Adults: swine, cattle, sheep, rarely horses. Immatures: rodents, hares, foxes, shrews.	An occasional zoonotic CCHF vector.	A 2-host tick. Has a 1-year life cycle. Adults overwinter. May become inactive if a host is not found in the summer.
R. sanguineus	Throughout the Middle East.	Adults: dogs, cattle, horses, sheep, sometimes man. Immatures: same.	An occasional CCHF vector. Also vectors boutonneuse fever.	A 3-host tick. Adults frequent the ears, or between toes of dogs. Immatures prefer long hair at the back of the neck. Females crawl upward and lay eggs in cracks of walls or ceilings.
R. turanicus	Israel, Jordan, Lebanon.	Adults: camels, sheep, goats, man. Immatures: gerbils, rodents, dogs.	Transmits boutonneuse fever.	A 3-host tick. Lays eggs in dens of hosts. Requires a humid environment. Relatively passive in questing habits.